



# STW43NM50N

N-channel 500 V, 0.070  $\Omega$ , 37 A MDmesh™ II Power MOSFET  
TO-247

## Features

Type	V <sub>DSS</sub> @ T <sub>jmax</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STW43NM50N	550 V	< 0.085 $\Omega$	37 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

## Application

- Switching applications

## Description

This series of devices implements second generation MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

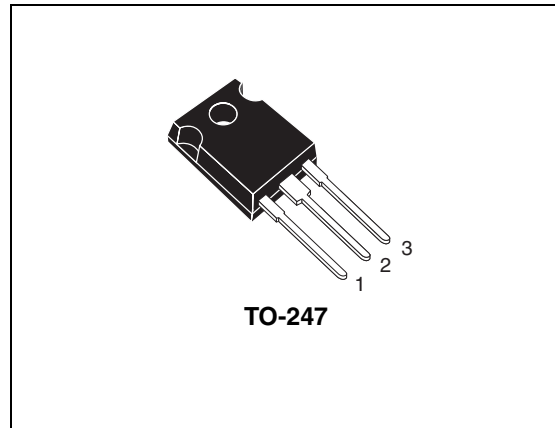


Figure 1. Internal schematic diagram

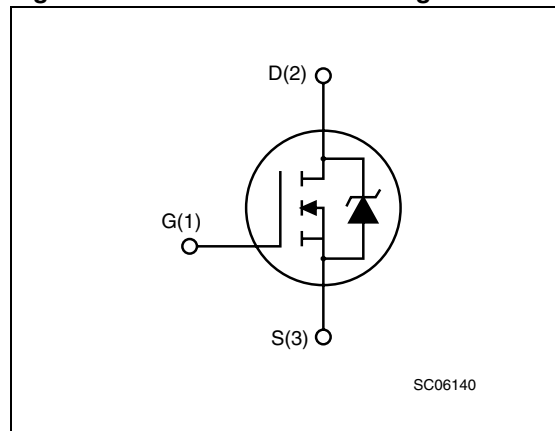


Table 1. Device summary

Order code	Marking	Package	Packaging
STW43NM50N	43NM50N	TO-247	Tube

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	500	V
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	37	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	23	A
$I_{DM}^{(1)}$	Drain current (pulsed)	148	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	255	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area
2.  $I_{SD} \leq 37\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.49	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^\circ\text{C}/\text{W}$
$T_I$	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AS}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	15	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J=25\text{ }^\circ\text{C}$ , $I_D=I_{AS}$ , $V_{DD}=50\text{ V}$ )	1000	mJ

## 2 Electrical characteristics

( $T_{CASE}=25\text{ °C}$  unless otherwise specified)

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	500			V
$dv/dt^{(1)}$	Drain source voltage slope	$V_{DD} = 400\text{ V}$ , $I_D = 37\text{ A}$ , $V_{GS} = 10\text{ V}$		30		V/ns
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$ , @ $125\text{ °C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 18.5\text{ A}$		0.070	0.085	$\Omega$

1. Characteristic value at turn off on inductive load

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{ V}$ , $I_D = 18.5\text{ A}$	-	18	-	S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	4200 290 20	-	pF pF pF
$C_{oss\text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0$ , $V_{DS} = 0\text{ to }400\text{ V}$	-	590	-	pF
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 400\text{ V}$ , $I_D = 37\text{ A}$ , $V_{GS} = 10\text{ V}$ , (see Figure 15)	-	140 72 23	-	nC nC nC
$R_g$	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain	-	1.4	-	$\Omega$

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

2.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DS}$

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250 \text{ V}$ , $I_D = 18.5 \text{ A}$ $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$ (see Figure 14)	-	30	-	ns
$t_r$	Rise time		-	20	-	ns
$t_{d(off)}$	Turn-off delay time		-	140	-	ns
$t_f$	Fall time		-	42	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		37	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		148	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 37 \text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 37 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see Figure 16)	-	530		ns
$Q_{rr}$	Reverse recovery charge		-	11		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	42		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 37 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 16)	-	630		ns
$Q_{rr}$	Reverse recovery charge		-	14		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	45		A

1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

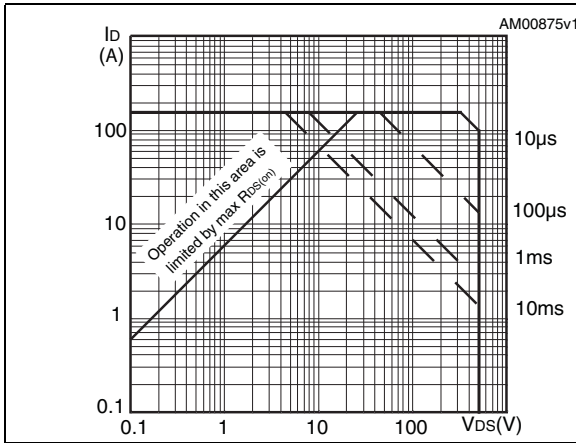


Figure 3. Thermal impedance

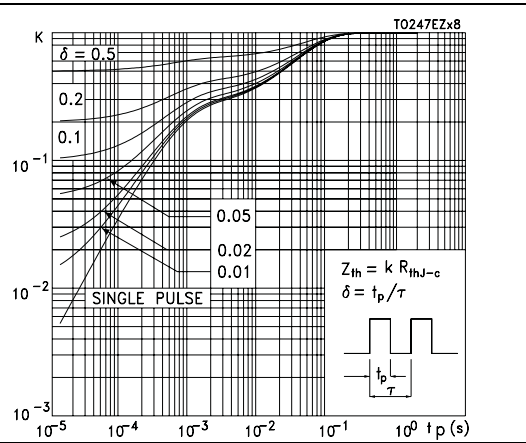


Figure 4. Output characteristics

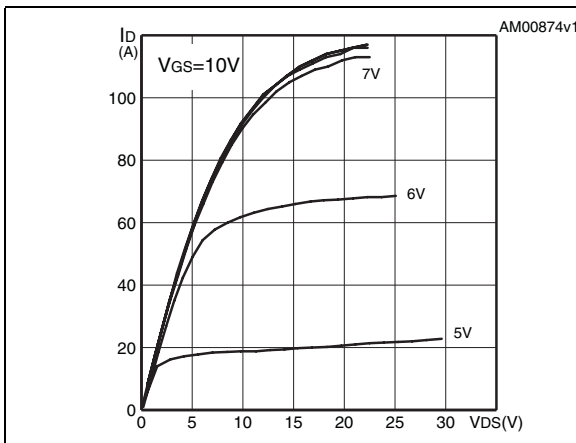


Figure 5. Transfer characteristics

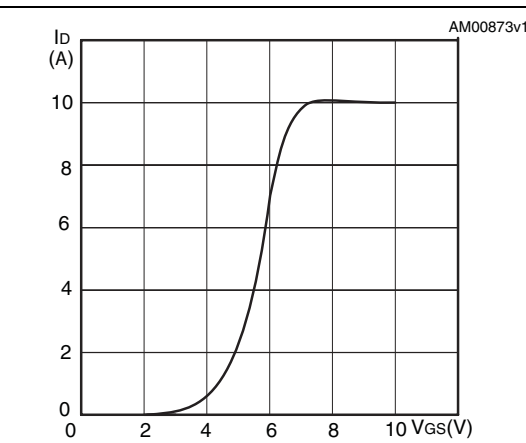


Figure 6. Transconductance

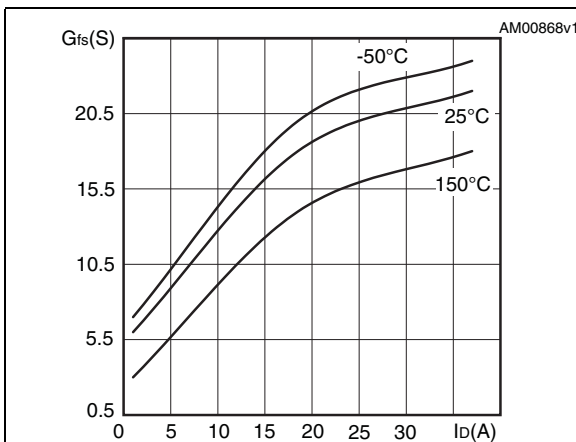


Figure 7. Static drain-source on resistance

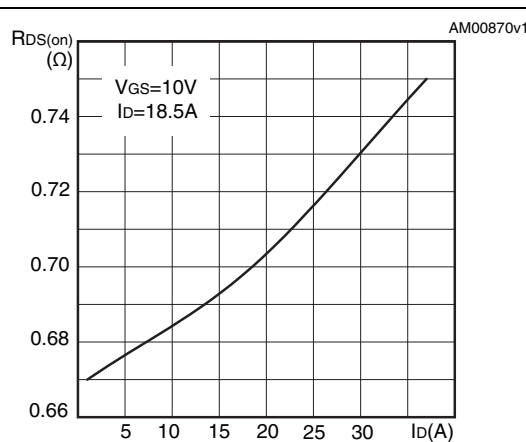


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

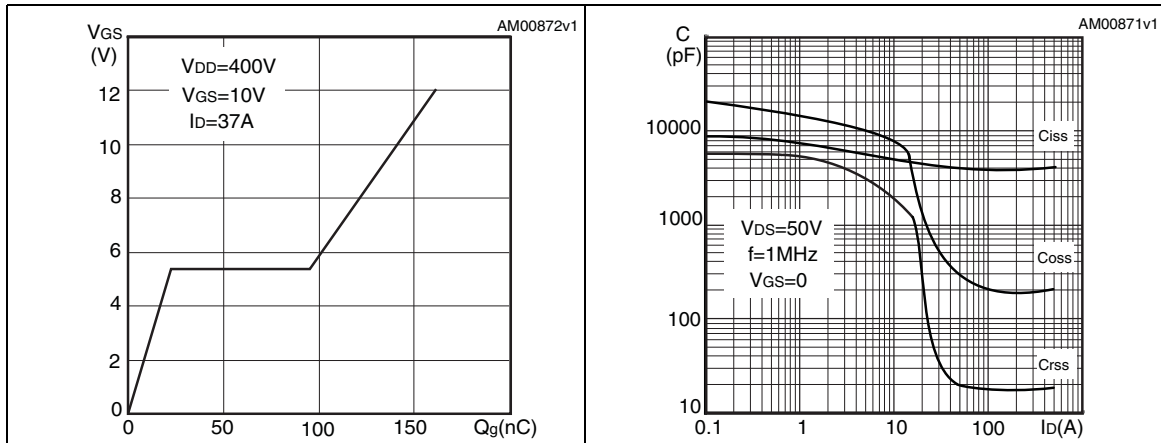


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

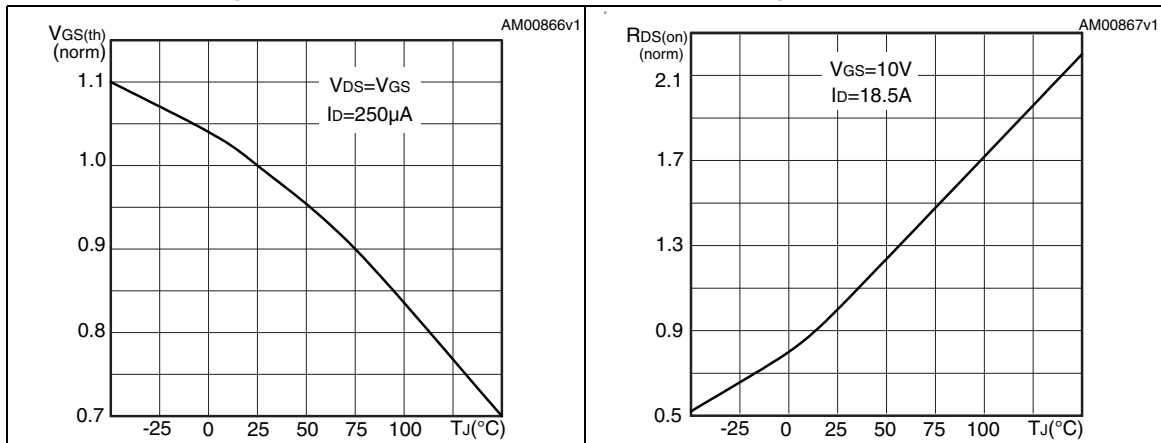
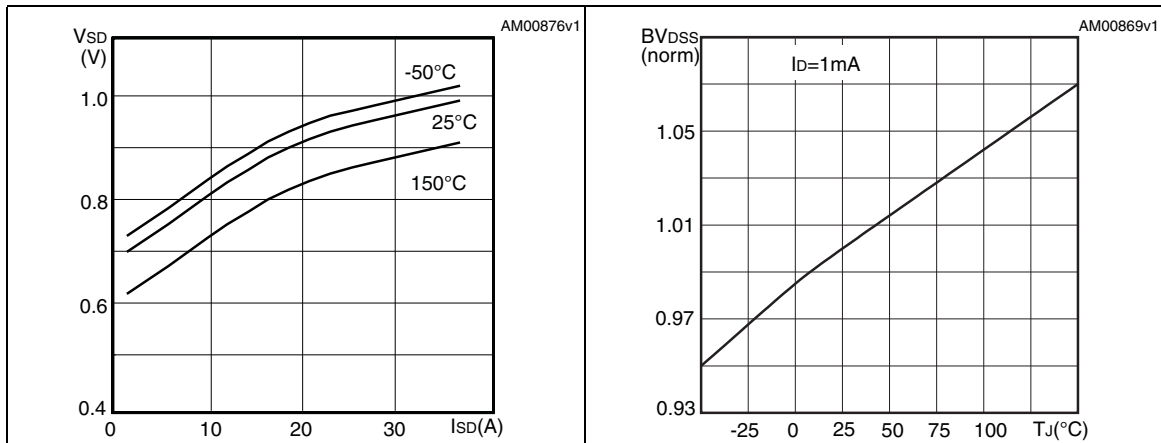


Figure 12. Source-drain diode forward characteristics Figure 13. Normalized  $B_{V_{DSS}}$  vs temperature



### 3 Test circuits

Figure 14. Switching times test circuit for resistive load

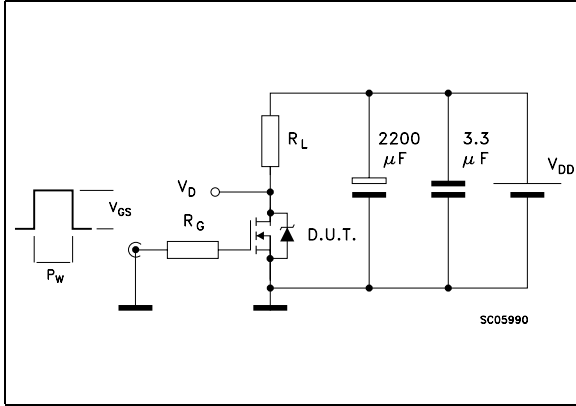


Figure 15. Gate charge test circuit

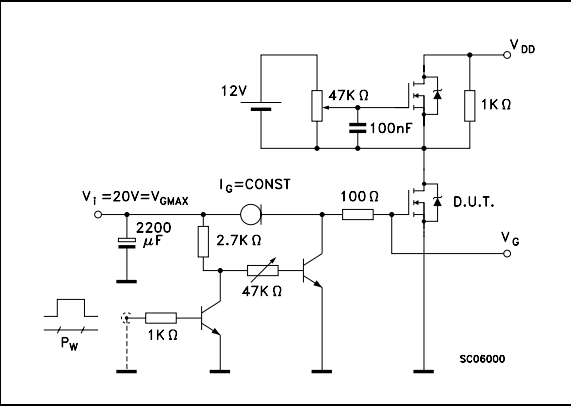


Figure 16. Test circuit for inductive load switching and diode recovery times

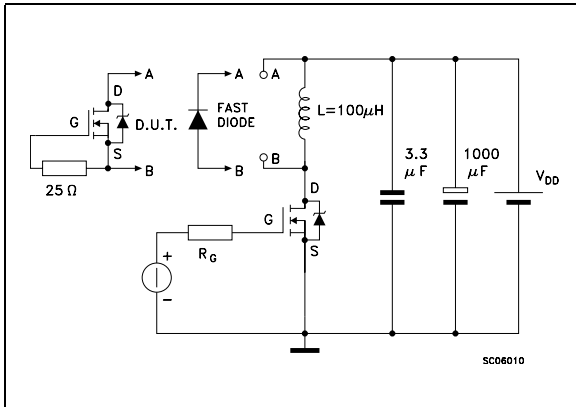


Figure 17. Unclamped inductive load test circuit

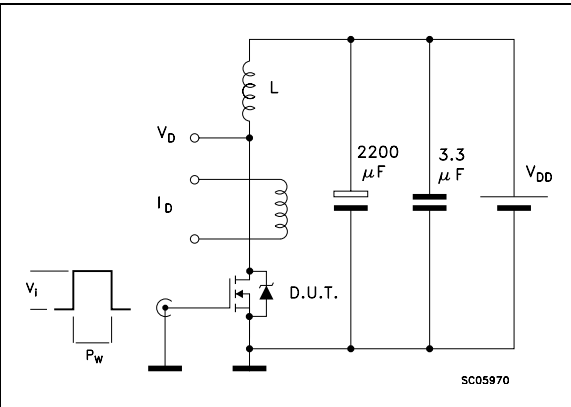


Figure 18. Unclamped inductive waveform

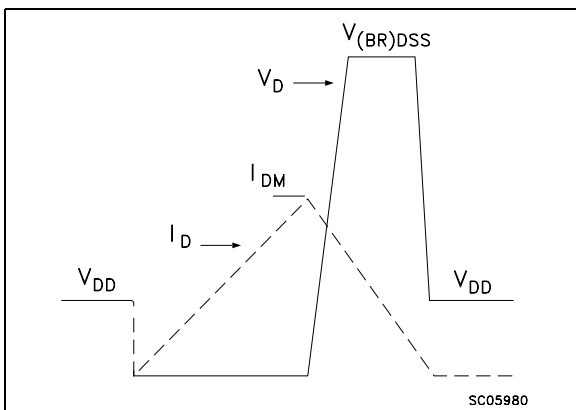
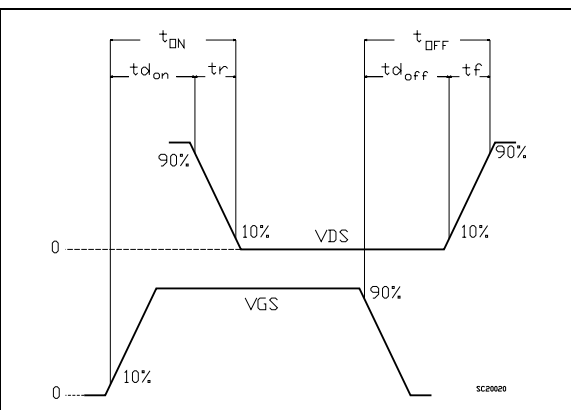


Figure 19. Switching time waveform



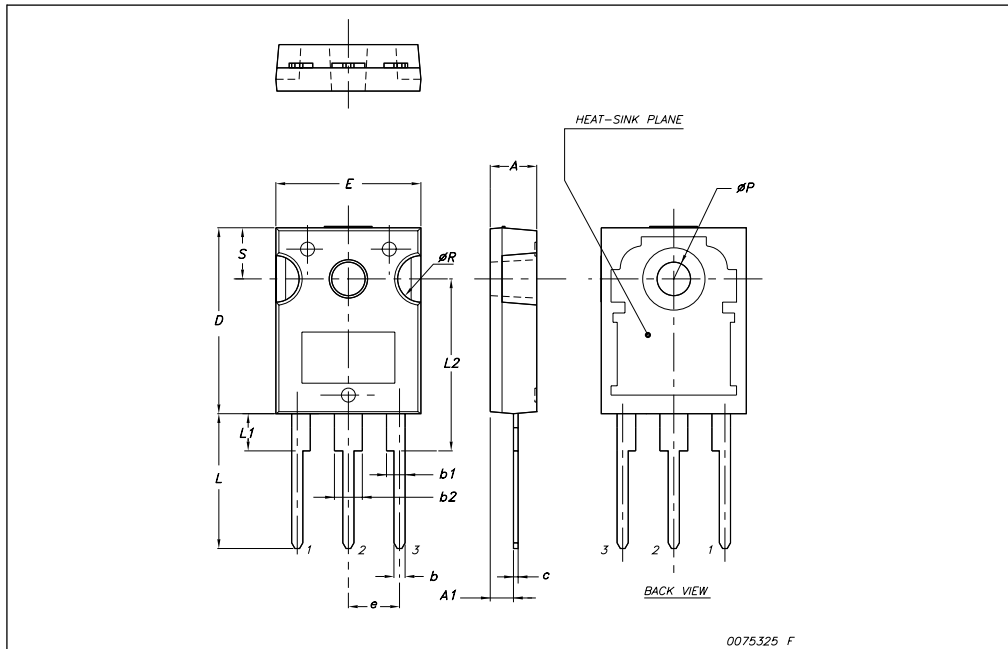


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

**TO-247 Mechanical data**

Dim.	mm.		
	Min.	Typ	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



## 5 Revision history

Table 9. Document revision history

Date	Revision	Changes
15-Nov-2007	1	First release
04-Aug-2008	2	Document status promoted from preliminary data to datasheet
15-Oct-2008	3	<a href="#">2.1: Electrical characteristics (curves)</a> has been corrected
27-Jan-2009	4	V <sub>GS</sub> value has been corrected in <a href="#">Table 2</a>
08-Jan-2010	5	Updated V <sub>GS</sub> on <a href="#">Table 2: Absolute maximum ratings</a> .

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